

Monitoring and Evaluation Report
Grand Valley Unit
Colorado River Salinity Control Project
2003

USDA-NRCS

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EXECUTIVE SUMMARY GRAND VALLEY 2003

HYDROSALINITY -

- ◆ The project plan is to treat approx. 60,000 acres with improved irrigation systems.
- ◆ To date, 32,581 acres have been treated with improved irrigation systems.
- ◆ The project plan is to reduce salt loading to the Colorado River system by 132,000 tons of salt.
- ◆ In FY 2003, salt loading has been reduced by 3,244 tons of salt per year as a result of installed salinity reduction practices.
- ◆ The cumulative salt reduction applied is 90,314 tons/year, or 68 percent of the goal.

COST-EFFECTIVENESS -

- ◆ The planned cost per ton of salt saved with FY 2003 contracts (one year) is \$48.31/Ton. This figure is calculated as follows:

$$FA + TA = \text{Total Cost} \times \text{Amortization factor} = \text{Amortized cost}$$
$$\text{Amortized cost} / \text{Tons salt reduced} = \text{Cost/Ton}$$
$$FA = \text{Total dollars obligated in EQIP and Parallel Program (including wildlife)}$$
$$\text{Amortization for 2003} = 0.07546$$

ECONOMIC AND SOCIAL -

- ◆ Contract inactivity - During the past fiscal year, there were **no** contracts found in non-compliance, and there were **no** expired or cancelled contracts with remaining items to complete.

OTHER PROGRAM BENEFITS -

- ◆ There has been a positive effect to local landowners as a result of salinity practice implementation. The main benefit continues to be labor savings associated with on-farm and off-farm irrigation improvements.
- ◆ Irrigation improvements, both on- and off-farm, are beginning to be seen as valuable improvements in city and county planning departments, and the program is finally receiving support as irrigation improvements are codified in development regulations.
- ◆ Landowners irrigating with water from the Grand Valley Water Users' Association have benefited from lower water use, and therefore, lower water costs, as this system charges for water on a volume basis. Water use has been documented in landowner case files.
- ◆ Fertilizer use and efficiency contributes to increased yields and lower production costs.

EXECUTIVE SUMMARY GRAND VALLEY 2003

OTHER RELATED ITEMS -

- ◆ The project awards ranking points for control of irrigation-induced erosion.
- ◆ The application of PAM is becoming more widespread as a field application for erosion control and irrigation efficiency improvement, and as treatment for seepage of earthen canals.
- ◆ There is a funded education program as it pertains to work performed one-on-one with individual landowners. Each landowner receives follow up education and demonstration pertaining to Irrigation water management. A small farm acreage and management course is presented at Mesa State College.

M&E EXECUTIVE SUMMARY- WILDLIFE

Grand Valley 2003

Habitat Acres (Includes both upland and wetland) (2003 figures includes 37 acres applied with USDA programs other than salinity).

Cumulative Acres Applied 2002	Cumulative Acres Applied 2003	Acres Left to Apply (750 Goaled)
394.5	341*	409

* The wildlife habitat replacement acreage total is 410 acres for the history of the program. A recent evaluation completed by NRCS staff has found that habitat replaced in past years is no longer present due to poor management and/or urban encroachment.

Wetland Data from 1991-2003

Cumulative acres impacted year 1991-2002	Cumulative acres impacted year 2003	Net AREM Unit change 1991-2002	Net AREM Unit change 1991-2003	Net change
+22.4	+6.0	+31.96	32.62	+0.66

Funding for Wildlife Habitat 1996-2002

% of total funds spent on wildlife through 1996-2002	% of total funds spent on wildlife through 2003
1%	1%

HYDROSALINITY MONITORING AND EVALUATION

In 2003, USDA-NRCS funded the monitoring of irrigations for USDA-NRCS Colorado River Salinity Control under the EQIP program through the Lower Basin States' monies. Equipment was set out at 2 sites in the Grand Valley study area in Western Colorado. Applied irrigation water to these fields was measured so that deep percolation losses of the water could be determined.

A meeting was held to ascertain the direction that the program should take with respect to satisfying the objectives of the hydrosalinity monitoring and education. It was decided to monitor 2 sites in the Grand Valley area (Mesa County), 4 sites in the Lower Gunnison area (3 in Montrose County and 1 in Delta County), and 2 sites in the Cortez (Montezuma County, McElmo Creek) area.

The 2003 irrigation season was characterized by unusually hot, dry windy weather in the early part of the irrigation season, much like the 2001 season and the beginning of the 2002 season, but even more intense in the month of July. In fact, several high temperature records were broken in July in all of the salinity control counties. This led to the high evapotranspiration rates throughout the early and middle portions of the season. The snow pack was reduced rapidly in the extreme weather conditions

An informal educational program was undertaken to assist homeowners to better irrigate their lawns.

The EQIP assisted irrigators appear to be using their structures and irrigation equipment efficiently, and the data suggests that this program is effective in assisting producers to reduce deep percolation losses of irrigation water and hence, salt loading of the Colorado River.

Several educational programs were undertaken to either present data from the monitoring program or to inform irrigators of proper irrigation methods and procedures.

Introduction

The Natural Resources Conservation Service (NRCS) has been placing improved irrigation methodology with selected cost-sharing to cooperators since 1979 through the Colorado River Salinity Control Program. Irrigations of several cooperators were monitored with flow measuring equipment to evaluate the effectiveness of the equipment to reduce deep percolation of irrigation water.

However, due to reductions in force as a result of budget restrictions, the monitoring efforts by the NRCS were forestalled.

Several entities led by the Salinity Forum requested that the monitoring of selected

irrigations in the Lower Gunnison, Montezuma County (McElmo Creek) and Grand Valley Salinity Control units be resumed.

Therefore, with monies derived from the Environmental Quality Incentive Program (EQIP) and funding from the Lower Basin States, we conducted the monitoring of irrigations in the three units.

The original monitoring plan required that separate irrigation sites be monitored throughout the irrigation season to assess the effectiveness of the improved irrigation systems and irrigation management in reducing deep percolation of irrigation water which contributes salt to the Colorado River system via a loading process.

Methods

A list of possible cooperator irrigators from the Mesa County (Grand Junction area) unit was supplied by the NRCS so that fields could be evaluated for monitoring suitability. This was accomplished and letters were drafted to the 2 selected cooperators to stipulate the terms of monitoring. Both sites had isolated inflow and outflow water sources; that is, they were not influenced by any other water sources. The selected cooperators agreed to contact the local NRCS office several days prior to the irrigation event so that proper measuring equipment could be installed.

Soil samples were taken shortly before any irrigations so that the antecedent soil moisture could be determined. This established the soil moisture deficit that had to be satisfied to fill the soil profile by irrigation. Subsequent soil moisture deficits were determined by calculating the evapotranspiration (ET) of the crops in the fields and subtracting the crop water use data from the pre-existing soil moisture. Any excess water applied over and above the crop water needs was considered to be lost to deep percolation. No consideration was given to leaching requirements to keep soil salinity at desirable levels.

Irrigation in the Mesa County area is characterized by mostly gravity-fed systems installed on heavy, clayey soils derived from a marine shale formation (Mancos shale) that is very saline. The intake rates of the soils are generally low to medium. By virtue of plentiful and inexpensive irrigation water coupled with the heavy clay soils, long irrigation set times and excessive flow rates are the norm. This leads to deep percolation losses of water and low efficiencies of application. The excess deep percolation water contacts the underlying Mancos shale and subsequently loads salt to the Colorado River. Therefore, the USDA-NRCS Field Office has designed and overseen installations of improved irrigation structures and procedures under the auspices of the Colorado River Salinity Control Program. This program has been underway for about 25 years.

Site 1 had an existing flow meter that had been installed previously by the US Bureau of Reclamation. This meter was utilized to measure the water onto the field. Water off of the field (tail water) was measured by installing an 18" broad-crested flume in the end of the tail water ditch. In order to measure the water on to the field, Site 2 was provided

with a propeller flow meter that fit onto the delivery pipe to measure inflow to the field. The meter records both real time flow and totalizes it in terms of gallons.

It was read before and after each irrigation. The tail water was measured by installing a 12" broad-crested flume at the point where the water left the field.

Stage height sensors and recorders purchased from Omnidata Corp. were installed on the flumes and held in place by bolting them to the frame of the flumes. The equipment senses the pressure exerted by the water in the flume, converts the pressure to height in feet and records the height internally for later retrieval. A portable computer was employed to retrieve the data from the field flumes. The data was then analyzed by a computer program developed in-house to convert the water height to flow.

Concern has been voiced about the abuse of water by homeowners in the area, and indeed, in the southwest area of the United States. In many instances, water is applied at many times the evapotranspiration (ET) rate, simply out of ignorance on the part of the homeowners. We attempted to work with 2 selected homeowners to assist them in the proper irrigation sequence necessary to maintain a healthy lawn without gross over-applications of water to the lawns.

The area selected is comprised of middle-class homes on large lots. The area was once an alfalfa field and the houses have been established for about 30-35 years. Homeowners pay \$125.00 per year for unmetered and untreated river water, delivered to their lots via underground pipe. This practice is common throughout the Grand Valley as farm ground is converted to suburban use. Although the water arrives at most lots with a minimum amount of pressure, pumps must be employed to drive several sets of sprinklers.

Two homeowners were selected who had at least 2 zones of irrigation in their lots. We requested that they irrigate 1 zone at the time we suggest they irrigate, and they could irrigate the other at their discretion. Regrettably, one of the homeowners opted out of the practice about midway through the season. The other stayed with the program through the remainder of the season. We measured the water applied to the zones with NRCS rain gauges.

This office frequently receives inquiries from irrigators, many of them new to the area and thus to irrigation, concerning the proper method of irrigation to be used. We worked with a few of these irrigators to assist them in the art of proper irrigation, which resulted in greatly decreased deep percolation losses of their irrigation water. Without this assistance, it is possible that these irrigators could conceivably negate the positive effects of the EQIP irrigations on an acre to acre comparison.

In addition, we participated in several educational aspects of irrigation in a sponsored workshop conducted by Colorado State University. Also, we presented a workshop on salinity to CSU's Master Gardener program. We participated in a short course devoted to small acreage management developed through NRCS and Mesa State College. Mr.

Currier took the lead in developing a syllabus for the course.

Results

Equipment was set out in the field to monitor irrigations on two different sites in the Grand Valley monitoring area. The first site (site 1) was north of the town of Loma and is about 21.4 acres in size. The second site (site 2) is northeast of Fruita and is comprised of about 2.3 acres. Site 1 was planted to feed corn. Nine irrigations yielded useable data. Site 2 was planted to feed oats which were irrigated frequently and lightly 8 times.

The application amounts and deep percolation amounts of irrigation water are presented in terms of acre-feet per acre at the end of the report. There are minimal deep percolation losses of irrigation water at site 2. Site 1 exhibited more deep percolation losses, but still within the acceptable range. Amounts of deep percolation losses are presented in the appendix at the end of the report.

About 82% of the deep percolation losses at site 1 occurred during the first four irrigations, and indeed, 42% occurred during the first 2 irrigations. The relatively short time interval between the third and fourth irrigations may have contributed somewhat to the deep percolation losses observed for the fourth irrigation. Later deep percolation losses were not as significant. It was not uncommon to see daily reference evapotranspiration (ET) rates in excess of 0.4" throughout much of the irrigation season. This depleted the soil moisture rather rapidly, and the observed deep percolation losses of irrigation water reflected this situation, especially in the month of July.

We have considered deep percolation to be the primary indicator of the effectiveness of the irrigation application; others may be concerned with the efficiencies of the irrigation. Since the deep percolation losses of water are the main contributor of salt loading to the river system, that figure holds our greatest interest. Previous studies have shown that surface water runoff (tail water) does not change appreciably with respect to salinity in the water as it travels from the head of the field to the bottom of the field, but does increase dramatically with respect to sediment load, particularly after a tillage procedure during the first several irrigations on a row crop field. Sediment increases in alfalfa and pasture (grass) irrigated fields are minimal as well as salinity increases. In fact, we have observed a "cleansing" of the irrigation water as it traverses these fields of alfalfa and pasture.

Site 2 was planted to a field of oats with buried pipe serving gated pipe and a surge irrigation valve and controller. The field was irrigated frequently and with relatively short set times (Appendix). This, coupled with the unusually warm weather during the mid part of the irrigation season, minimized deep percolation losses of applied water. Efficiencies of irrigation events were adequate due to this procedure. Even though the

runoff was greater with this type of irrigation scheme than with conventional, longer sets of irrigation, the deep percolation losses were minimized. The efficiencies of irrigation could be increased by decreasing the flow rate minimally. About 63% of the measured deep percolation occurred during the first 2 irrigations.

The yield of the oats was not as great as the grower had anticipated; however, he blamed the hot weather during grain fill as a contributing factor to the reduced yield. In addition to monitoring irrigations of the aforementioned EQIP cooperators, we responded to 52 telephone calls from irrigators in Mesa County. Generally, we were either able to assist these people in improving their irrigation procedures or to steer them to the proper NRCS personnel in the Grand Junction Field Office. Several problems were solved by field visits.

Both cooperators wish to remain anonymous in this report.

Educational Activities

We participated in several educational activities in the Grand Junction area. One of the more successful activities was a presentation on salinity to the Tri-River Master Gardener class. This event was attended by 130 people.

We participated in a small acreage management class sponsored by NRCS and Mesa State College. Responses to the programs were generally very favorable.

Urban Use of Irrigation Water

Although not a part of the EQIP program and the monitoring requirements of the position, we have been concerned about the abuse of irrigation water by suburban and urban users, both newcomers to the area as well as experienced homeowners. An informal measurement of lawn watering by homeowners confirmed this suspicion in the 2003 irrigation season. We placed several rain gauges in 2 yards where a fee is paid yearly for untreated water; the water is not metered and may be used constantly if desired. This water is delivered in a separate system from municipal treated water in many areas of the Grand Valley. The gauges were checked after each irrigation and the water use was recorded.

When we compared water use by the homeowners to the calculated evapotranspiration (ET) rates, we found that the water use exceeded the ET rate by a factor of 3.1 in one case and by 2.4 in the second case. This may have resulted in significant deep percolation losses. It must be stressed, however, that this is not a scientific study, but a casual observation on our part.

Nevertheless, it confirms suspicions that many observers have had regarding suburban water use.

We worked with these same 2 homeowners during the 2003 season. We requested

that we be allowed to determine when to irrigate 1 of the zones on the lots and that the homeowners could irrigate the other zones when they pleased. However, one of the homeowners opted out of the program shortly into the season claiming that it was too difficult to keep track of when to irrigate separate zones.

The remaining homeowner was interested in keeping with the program; he irrigated approximately 3.8 times ET on his zone, and the program zone was irrigated at approximately 2.2 times ET, resulting in a water conservation of about 42%. No adjustments were made for sprinkler irrigation efficiency. An impartial judging verified that the program zone had fewer weeds and appeared greener than the homeowner zone.

Conclusions

1. Deep percolation losses of applied irrigation water were observed, but were minimal due in part to several factors:
 - a. The improved systems are effective in enabling producers to apply irrigation water efficiently
 - b. The irrigators used their water judiciously
2. The antecedent soil moisture and management considerations appear to be the major factors in governing deep percolation of irrigation water.

Recommendations for Future Monitoring

Monitoring in the salinity control areas has been accomplished and further monitoring would only be redundant. Efforts should proceed toward irrigation water management with selected irrigators.

Additional

Much of the information reported herein will be presented at several workshops to interested producers.

WILDLIFE

I. HISTORY AND BACKGROUND

The Grand Valley project area is located in west central Colorado adjacent to the Colorado- Utah border and includes the entire irrigated area of the Grand Valley North of the Colorado River and the area served by the Orchard Mesa Irrigation District on Orchard Mesa. The Grand valley and surrounding area is characteristic of the arid, cold desert ecosystem common to western Colorado and eastern Utah. Historically, the Grand valley was dominated by desert vegetation communities, with narrow wetlands and riparian zones along the Colorado and Gunnison rivers and some natural washes. The present mosaic cover types (agricultural, riparian, marsh, and desert shrub) are a direct result of current irrigation systems and practices. With the advent of irrigation (waste water, return flow and seepage), the natural vegetation changed from sparse, saltbush desert communities to crops or “natural” cover types such as marsh /riparian, cottonwood, tamarisk, saltbush and greasewood. Natural cover types are restricted to areas unsuitable for agriculture, such as canal and lateral banks, fence rows, washes, irrigation return flows and drains, roadsides, and other low-lying areas.

The agricultural areas composed of orchards pastures, and crops such as alfalfa, corn and small grains, that are entirely dependent upon irrigation for production. The area originally comprised about 66,000 acres of agricultural land used for agricultural production; however development over the last 25 years has probably reduced the actual amount of land available for cultivation to approximately 58,000 acres. The Grand Valley landscape is for the most part characterized by small (1 to 20 acre) parcels of irrigated land subdivided from traditionally larger units. As one progresses West and North of Fruita and Loma, larger irrigated fields still remain, and traditional farming and agriculture reign. The impact of development is becoming apparent even in these areas.

Impacts to wildlife and habitat in the Grand Valley were addressed originally with the Grand Valley Environmental Assessment, prepared jointly by the US Bureau of Reclamation, USDA, and the US Fish and Wildlife Service. The Environmental Assessment determined that 4000 acres of wildlife habitat would be lost do to the activities and construction of improvement of on-farm and off-farm irrigation systems in the Grand Valley. Based upon analysis of the potential impacts, the assessment and subsequent agreements by the agencies required replacement of the 4000 acres of wildlife habitat. Seventy percent of the replacement requirement was assigned to the US Bureau of Reclamation, and thirty percent or 1200 acres was assigned to the USDA, representing on-farm impacts. In the Grand Valley, wildlife habitat is replaced on an “acre for acre” basis.

In 1991, the Grand Valley unit began tracking wetland type and value changes based upon the Avian Richness and Evaluation Methods for wetlands of the Colorado Plateau (AREM). Wetlands impacted by planned conservation practices were evaluated using this method and Circular 39 from USDI to establish an existing habitat value. The impacted wetlands were re-evaluated using the above criteria to determine existing wetland habitat value. In 1993, The Bureau of Reclamation purchased approximately 400 acres of property for development of wildlife habitat to augment the On-farm (USDA) goal of 1200 acres.

II. Current Methods

Wildlife habitat replacement progress is tracked by acres. Additionally, wetland habitat value changes are assessed using AREM. Beginning in 2001, an audit was conducted of all wildlife progress and records to reconcile data from several program and record-keeping changes. Acreage and value/habitat changes were updated and reconciled. A field visit to each site was conducted to verify the progress and records. As of this writing, this effort is complete and all records are now accurate and verifiable. In an inter-agency meeting on December 10, 2004, it was agreed that only habitat development currently on the ground will be credited for habitat replacement. The NRCS replacement goal will remain 1200 acres of habitat less the acreage purchased by BOR to augment NRCS habitat replacement. At project end, past NRCS habitat development that no longer exists (due to a variety of reasons) will not be credited to NRCS. If at that time, NRCS determines that the initial project irrigation improvement goals are not attainable and the habitat impacts are less than originally estimated, any adjustments in the habitat replacement goals will be mutually agreed on by NRCS, BOR, and the USFWS. This process of reporting and field verification of program results and records will continue for the remainder of the program. The type of wildlife improvement practices has remained consistent over the years of the salinity program. Practices include ponds, establishment of permanent vegetation on upland and wetland sites, and tree and shrub planting. Pond construction includes membrane lining at all locations except where the pond is at equilibrium with existing water table. Pond location and construction is reviewed by the Fish and Wildlife service for depletion impacts, and impacts to endangered fish species, and designs include current applicable provisions and guidelines for their mitigation. Fencing is used for livestock exclusion.

III. Results

Results and progress from wildlife improvement in detail are listed in the accompanying EXCEL spreadsheet. This data represents the final audit and update for all wildlife progress in the Grand Valley to date, and are verified from field visits performed by a wildlife biologist. The data reflect upland and wetland habitat acres and wetland values, both planned and applied. Salinity and wildlife habitat improvements have been cost-shared by several different programs over the last 25 years; therefore progress is also presented by program.

Programs for salinity control include:

Grand Valley Salinity Control Program (GVSP)	1987 - 1995
Interim Environmental Quality Incentive Program (IEQIP)	1996
Environmental Quality Incentive Program (EQIP)	1997 -2004
Colo. River Salinity Control Program (CRSC)	1978 -1989
Colo. River Basin Parallel Program (BPP)	1998 – 2004

- Note that there is some overlap in programs.

Summary of Wildlife Habitat Applied:

Acres applied in all salinity programs 1978-2003	268 acres
Acres applied but not yet reported	36 acres
TOTAL	304 acres

Acres applied with Wildlife Habitat Incentives Program: 37 acres

IV. Discussion of Results

A total of 1306 acres of wildlife habitat have been planned. Approximately 22 percent of projects planned were applied and still remain. Presently, cost share programs are being managed to reduce cancellation of wildlife practices, such as requirements that wildlife habitat be installed first or contemporaneously with irrigation development. Also, practice lifespan for practices associated with wildlife habitat are longer, now 20 to 25 years, so retention rates should now increase. GVSP program practice life was set at ten years. The data reveal that smaller and smaller acreages are being offered by landowners for habitat improvement, which parallels the general direction of the cost share program in general. Progress reported tends to be in increments of tenths of acres up to just two or three acres at most. The unit sizes of the vast majority of program participants are smaller, given the surge in development and subdivision of farms in the Grand Valley. It is difficult to locate areas on these smaller parcels that can

be sheltered and otherwise protected from roadways and headquarters.

In general, landowners that have truly developed and retained an interest and desire for wildlife habitat development have done the best job in retaining and managing the acreages, as evidenced by some practices installed by GVSP participants that are still on the ground some twenty years later in spite of practice life that ended years ago.

V. Conclusion

The results to date confirm that more effort must be placed upon increasing the interest among landowners to establish and maintain wildlife habitat. Development impacts are impacting the salinity control program in general and are certainly impacting the planning and application of wildlife as well. Many new landowners and participants are moving from the city to these newly created smaller parcels. The Grand Valley area is beginning to see a shift in how these landowners view and manage these parcels. These landowners for the most part, purchase these parcels for open space, viewscape, more space and privacy and rural quality of life. As such, they typically consider their parcels as "extra-large lots, rather than farms or agricultural pursuits. While many of these landowners still are interested in improving their land and irrigation, many do not do so for productivity or other reasons that are traditionally agricultural. The Programs and Assistance available to this segment of landowners must adjust to this shift. It is possible to capitalize on this shift by demonstrating the benefits of improving the open space for wildlife habitat. The size of these parcels will result in a continuing scenario of smaller acreages and projects for wildlife, however it is a segment that cannot be ignored, for it is the direction the Grand valley is taking for the foreseeable future. Other opportunities should be pursued in the Grand Valley, as follows:

- Working closely with conservation easement holders to develop wildlife Habitat
- Locating larger remaining parcels of land and initiating direct contacts
- Locating areas and land parcels along existing drainage corridors such as washes that could be developed

APPENDICES

Site 1. Billings silty clay loam, Field corn. 21.4 acres. Gated pipe from underground pipe.

	-----Acre-feet/acre-----					hours
<u>Irrigation Dates</u>	<u>Soil Moisture Deficit</u>	<u>Irrigation Amount</u>	<u>Infiltration</u>	<u>Deep Percolation</u>	<u>Time</u>	
6/2	0.29	0.72	0.44	0.15	48	
6/18	0.35	0.88	0.48	0.13	54	
6/28	0.30	0.78	0.39	0.09	48	
7/2	0.14	0.70	0.32	0.18	48	
7/14	0.31	0.68	0.29	<0.02>	48	
7/20	0.20	0.64	0.31	0.11	48	
8/1	0.31	0.58	0.25	<0.06>	48	
8/12	0.20	0.64	0.25	0.05	48	
8/23	0.28	0.63	0.32	0.04	48	

<> Denotes deficit irrigation

Site 2. Youngston loam. 2.3 acres. Feed Barley. Gated pipe with surge.

	-----Acre-feet/acre-----					Hours
<u>Irrigation Dates</u>	<u>Soil Moisture Deficit</u>	<u>Irrigation Amount</u>	<u>Infiltration</u>	<u>Deep Percolation</u>	<u>Time</u>	
4/19	0.41	1.06	0.53	0.12	32	
4/29	0.20	0.55	0.32	0.12	24	
5/22	0.44	0.72	0.45	0.01	24	
5/31	0.24	0.51	0.25	0.01	24	
6/10	0.29	0.64	0.35	0.06	24	
6/20	0.21	0.49	0.23	0.02	24	
6/28	0.31	0.57	0.31	0.00	24	
7/8	0.37	0.76	0.41	0.04	24	